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(54) NON-RETURN FLUID-FLOW VALVES

(71) We, ADAN HYDRAULICS LIMITED, a British Company, of Gresham Road, Staines, Middlesex, and JOHN HAROLD CURTIS, a British Subject of the Company's address, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a non-return fluid-flow valve.

The invention provides a non-return fluid-flow valve comprising an inlet passage, an outlet passage, a main valve closure member for sealing the inlet passage from the outlet passage, a fluid pressure chamber defined in part by the reverse face of the main valve closure member, a vent passage for venting the pressure chamber, means for selectively opening and closing the vent passage, and a throttle passage permanently connecting the outlet side of the valve to the pressure chamber, wherein the diameter of the throttle passage is narrower than the diameter of the vent passage, so that, during reverse flow, when the vent passage is opened a pressure differential is set up across the main valve closure member unseating the latter from its sealing position so that fluid may pass from the outlet passage to the inlet passage.

The vent passage may be formed in the main valve closure member to connect the inlet side of the valve to the pressure chamber. The means for selectively opening and closing the vent passage may include a secondary valve closure member for sealing the pressure chamber from the fluid supply side of the valve. When the secondary member is in its closed position the pressure chamber is sealed from the inlet passage and when it is in its open position fluid passes from the pressure chamber to the inlet passage. The main valve closure member may be provided with an extension sleeve, a pin slidably mounted in the sleeve being movable, in use, to open the secondary valve closure member. Alternatively, the vent passage may be provided at a position remote from the main valve closure member and in communication with the low pressure side of the pressure fluid supply system, e.g. in a passage leading from the pressure chamber to a fluid supply reservoir.

In both cases the throttle passage equalises the pressure in the pressure chamber and the outlet passage.

The secondary valve closure member may be actuated by mechanical, electro-mechanical or hydraulic forces against the force of spring means biasing the secondary member against a valve seat formed in the vent passage.

The invention will be further described, by way of example only, with reference to the drawings accompanying the Provisional Specification, in which:—

Figure 1 is a cross-sectional side elevation of a first non-return fluid-flow valve; and

Figure 2 is a cross-sectional side elevation of a second non-return fluid-flow valve; and with reference to Figure 3 of the accompanying drawing, which shows a modification of the valve shown in Figure 1.

Figure 1 shows a valve housing 1 formed with an inlet passage 2 and an outlet passage 3. A main valve closure member in the form of a poppet assembly 4 is held against a valve seat provided by a shoulder 5 in the inlet passage by means of a spring 6. A hollow cylindrical base portion 7 of the poppet 4 defines together with the housing 1 a pressure chamber 8, the spring 6 being held between the housing wall 9 and an internal shoulder 10 formed in the base portion 7. The base portion 7 of the poppet 4, which effectively seals the chamber 3 from the outlet passage 2, is provided with oil grooves 11. The poppet 4 is also formed with a restricted throttle bore 12. A passage 13 formed in the head 14 of the poppet provides fluid communication between the pressure chamber 3 and the inlet passage 2. A secondary valve closure member in the form of a pilot poppet 15 is held against a valve seat formed by a shoulder 16 in the head 14 by means of a spring 17. Although the pilot poppet is shown as a frusto-conical member it can be made in any shape and could, for example, be

spherical in form. The spring 17 is positioned between the rear face of the pilot poppet 15 and a hollow bush 18 is screwed into the rear end of the passage 13.

In normal operation, when the pressure in inlet passage 2 is greater than in passage 3 by an amount determined by the force of spring 6, the main poppet assembly 4 will unseat to allow fluid between passage 2 and 3. When flow ceases the poppet assembly 4 closes.

If it is required to have fluid flow in the reverse direction, that is from outlet passage 3 to inlet passage 2, then a push rod 19 is actuated, e.g. by electromechanical, mechanical or hydraulic forces to unseat the pilot poppet 15 against the biassing effect of the spring 17 and the fluid pressure in chamber 8. This permits fluid to flow from chamber 8 through the passage 13 and into the inlet passage 2. In this condition a pressure differential is obtained between the chamber 8 and the passage 3 and this differential increases, at a rate controlled by the relative dimensions of the passage 13 and the throttle bore 12, until the force of spring 6 is overcome whereupon the main poppet assembly 4 becomes unseated. Consequently, fluid flow then flows from the outlet passage 3 to the passage 2.

When the push rod 19 is retracted pilot poppet 15 reseats and the pressure in chamber 8 and the passage 3 is equalised *via* the throttle bore 12 so that the main poppet 4 is caused to reseat by the spring 6.

The non-return valve illustrated in Figure 2 is very similar in construction and operation to the valve illustrated in Figure 1. Accordingly, similar parts have been identified in Figure 2 by corresponding primed reference numerals. The main difference between the two valves is that in the Figure 2 construction the pilot poppet 15^1 is not mounted within the main poppet 4^1 but is positioned in a passage 20 providing communication between the chamber 8^1 and a fluid supply reservoir (not shown). The poppet 15^1 is held against a seat provided by a hollow bush 21 secured into the passage 20, by means of a spring 22. One end of the latter abuts the bush 21 and the other end abuts a shoulder 23 in the passage 20. A restricted throttle passage 24 is formed in the housing 1^1 of the valve and provides communication between the chamber 8^1 and the outlet passage 3^1.

In normal operation, when pressure in the passage 2^1 is greater than that in passage 3^1, the main poppet 4^1 becomes unseated thus allowing free flow of fluid from inlet passage 2^1 to outlet passage 3^1. On cessation of flow the main poppet 4^1 closes onto its seat thereby preventing reverse flow from outlet passage 3^1 to inlet passage 2^1.

When a push rod 19^1 is actuated (in similar fashion to rod 19) it unseats the pilot poppet 15^1 and consequently pressure in chamber 8^1 decreases. The relative dimensions of the throttle passage 24 and the passage 20 controls the pressure differential between the chamber 8^1 and the outlet 3^1 and when the resultant force produced by this differential reaches a predetermined value defined by the spring 6^1, the main poppet 4^1 is unseated thus allowing fluid flow from chamber 3^1 to chamber 2^1. Retraction of the push rod 19^1 allows poppet 15^1 to be reseated under the combined effect of fluid pressure and the spring 22. The pressure in chamber 8^1 and passage 3^1 is then equalised *via* the throttle passage 24 so that the main poppet 4^1 is caused to reseat by the spring 6^1.

In Figure 2 the pilot valve assembly is formed in the valve housing 1^1. As an alternative to this construction the pilot assembly could be located quite separately, and remote from, the main valve assembly.

Figure 3 shows a modification of the valve shown in Figure 1 and accordingly similar parts are identified in Figure 3 by corresponding double primed reference characters. In this construction the head 14^{11} of the main valve closure member is provided with an extension in the form of a cylindrical sleeve 25 having a number of radially extending ports 26. Slidably mounted in the sleeve 25 is a striker pin 27, one end of which is formed with a head 28 and the other end of which is provided with a tapered portion 29. Mounted within the main valve closure member, which is arranged to seat on a valve seat insert 30, is a secondary valve closure member in the form of a pilot ball 31 which is held against a valve seat, formed by a shoulder 16^{11} in the head 14^{11}, by means of a spring 17^{11}. The spring 17^{11} is positioned between the pilot ball 15 and a hollow bush 18^{11} screwed into the rear end of passage 13^{11}. As in the Figure 1 construction a hollow cylindrical base portion 7^{11} of the main poppet 4^{11} defines together with the housing 1^{11} a pressure chamber 8^{11} but here the spring 6^{11} is held between a housing plug 32, provided with a seal 33, and the internal shoulder 10^{11} formed in the base portion 7^{11}.

Normal operation of the valve illustrated in Figure 3 is identical to that described for the valve shown in Figure 1, i.e. the main poppet assembly 4^{11} is unseated to allow fluid flow between passage 2^{11} and 3^{11}. If it is required to have fluid flow in the reverse direction, that is, from the outlet passage 3^{11} to the inlet passage 2^{11}, then a push rod 19^{11} is actuated to unseat the pilot poppet 31 by engagement with the striker pin 27. This permits fluid to flow from chamber 8^{11} through passage 13^{11} and the ports 26 and into the inlet passage 2^{11}. In this condition

a pressure differential is obtained between the chamber 8^{11} and the passage 3^{11} and this differential increases, as in the case of the Figure 1 construction, at a rate controlled by the relative dimensions of the passage 13^{11} and ports 26^{11} and the throttle bore 12^{11}, until the force of spring 6^{11} is overcome whereupon the main poppet assembly 4^{11} becomes unseated. Consequently, fluid then flows from the outlet passage 3^{11} to the passage 2^{11}.

The non-return valves described above have application wherever fluid-flow is required in one direction, and in certain circumstances, where reverse flow is also required. In particular, the valves would, for example, have application where pressure fluid is required to raise and to positively hold in position a load by means of a ram, reverse flow being utilised to lower the ram under gravity when necessary. In this case, the valve may be built into the ram itself. The valves would also be useful for controlling fluid flow to a clamping device used in a guillotine press. Here, pressure fluid is passaged through the valve in one direction to lower the clamp and to hold it positively on a workpiece during shearing, whilst reverse flow is used to release the clamping load on the workpiece and to raise the clamp after shearing.

It will be evident that an advantage of the valves described above is that whilst they have a non-return effect during normal operation they can be opened, when necessary, against pressure with relatively low input power to provide reverse fluid flow. Furthermore, the pilot valve can also reduce system shocks by acting as a decompression valve.

WHAT WE CLAIM IS:—

1. A non-return fluid-flow valve comprising an inlet passage, an outlet passage, a main valve closure member for sealing the inlet passage from the outlet passage, a fluid pressure chamber defined in part by the reverse face of the main valve closure member, a vent passage for venting the pressure chamber, means for selectively opening and closing the vent passage, and a throttle passage permanently connecting the outlet side of the valve to the pressure chamber, wherein the diameter of the throttle passage is narrower than the diameter of the vent passage, so that, during reverse flow, when the vent passage is opened a pressure differential is set up across the main valve closure member unseating the latter from its sealing position so that fluid may pass from the outlet passage to the inlet passage.

2. A valve as claimed in Claim 1 wherein the vent passage connects the inlet side of the valve to the pressure chamber.

3. A valve as claimed in Claim 2 wherein the vent passage is formed in the main valve closure member.

4. A valve as claimed in Claim 1 wherein the vent passage is provided at a position remote from the main valve closure member.

5. A valve as claimed in any of Claims 1 to 4 wherein the said means for selectively opening and closing the vent passage includes a secondary valve closure member which is opened by mechanical, electromechanical or hydraulic forces against the force of spring means biasing the secondary member against a valve seat formed in the vent passage.

6. A valve as claimed in any of Claims 2 or 3 or 5 when appendant to Claim 2 or 3 wherein the main valve closure member is provided with an extension sleeve, a pin slidably mounted in the sleeve being movable, in use, to open the secondary valve closure member.

7. A non-return fluid flow-valve substantially as herein described with reference to, and shown in, the drawings accompanying the Provisional Specification.

8. A non-return fluid flow-valve substantially as herein described with reference to, and as shown in, the accompanying drawing.

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1350379 PROVISIONAL SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

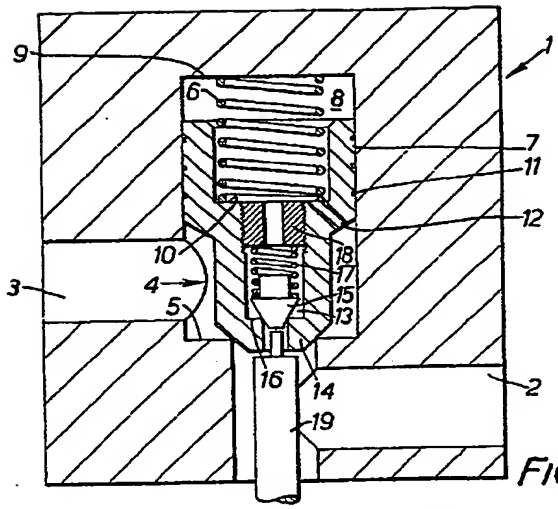

FIG. 1.

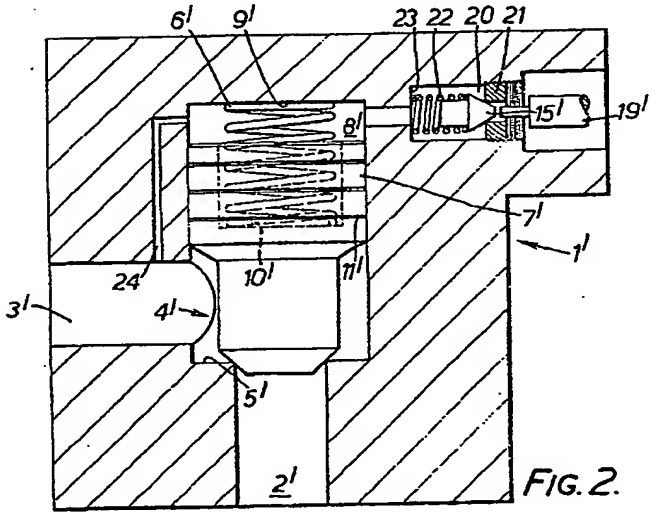

FIG. 2.

1350379 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

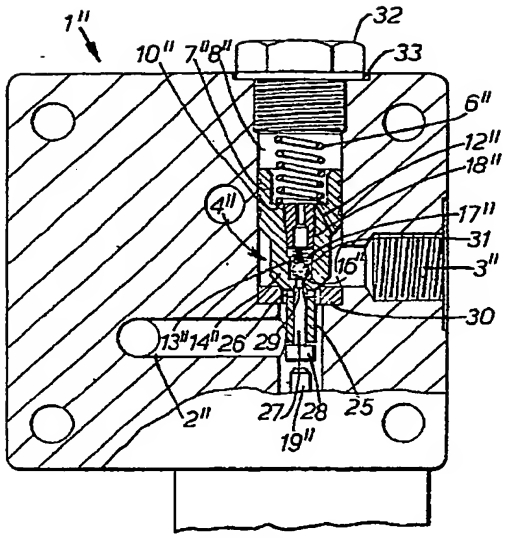

FIG. 3.